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HUMAN CROWD COUNTING AND ANALYSIS

Computation using OpenCV and TensorFlow

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Abstract: The most accurate human crowd-counting program is what we recommend creating. The software should capture an image that the user manually uploads, a video that the user uploads, or a camera where the population needs to be monitored. The OpenCV library is used to train and create the machine learning algorithm, which counts the number of people in each frame of the input feed. TensorFlow is the developed application that can be used as a standalone application or can be integrated with the other existing applications by exposing an API interface. The method counts the number of people in each frame. Unsupervised clustering is proposed to be developed in this application since it needs less training and is more suited for picture recognition. The developed application can be used as a standalone application or can be integrated with the other existing applications by exposing an API interface.

Index Terms **– Clustering, Human Crowd, Human Crowd Computation, Human Detection, OpenCV Library, Unsupervised Clustering, Image Recognition, Object Detection, Video Surveillance, K-Means Clustering.**

I.INTRODUCTION

The subset of object detection known as human detection detects items and labels them as humans if they satisfy the predetermined criteria. There are numerous human detection methods used, some of which include convolution neural networks, deep learning networks, and multi-layered compute-optimized algorithms.

The goal of clustering, also known as grouping, is to separate the data into groups of items that share similar traits. This method allows for the streamlining of data and information. This method is now being employed in a variety of contexts, including data recovery, spatial data analysis, marketing, support for medical diagnosis, and computational biology, among others. It may be applied to both supervised and unsupervised learning. In the specific instance of this literature study, the outcomes of the application of clustering to human activity recognition.

We can recognize and find things thanks to the detection program. In the field of study, the ability to count and precisely determine the detected object is crucial. Real-time computer vision is the primary focus of the Detection OpenCV Python library functionalities. Since clustering algorithms require significant visual differences, which must be calculated carefully to avoid implementation issues and accuracy issues, they are not frequently employed in object detection. The clustering algorithm that will be used must be specified. Together with this crucial choice, it is also essential to define a related proximity measure and build a criterion function. Since the proximity measure function was created, it has evolved into an optimization problem with numerous case studies.

To answer the initial challenge, clustering is used to demonstrate new information that has been derived from the original data. In some cases, it is required to speak with an expert to explain the cluster's resulting features to grasp the results.

The knowledge that has been extracted can also be explained and supported by more experiments.

II. NEED OF THE STUDY

Overcrowding in public spaces, which may be extremely unsafe and potentially problematic in every way, is a fundamental issue that everyone is currently dealing with. Managing a crowd of people may be incredibly challenging and time-consuming. combined with intense hard labor and many tedious repetitive activities. One of the recurring jobs was to point out that counting people and comparing them to the maximum crowd limit can be a tedious and time-consuming task with a high risk of error, which could lead to solutions that are susceptible to error.

In summary, the problem statement is automating the process of counting the number of people in a specific input source, be it a still image, a video, or a camera source. By making the necessary modifications, the produced application can be integrated with other apps already in use or used independently.

Data and Sources of Data

Even the most effective machine learning algorithms will fall short in the absence of high-quality training data because machine learning models are only as good as the data they are trained on. Early in the training process, it becomes clear that relevant, full, accurate, and high-quality data are required. Only with sufficient training data can the algorithm quickly identify the features and discover the links required for future prediction. More specifically, the most important factor in machine learning (and artificial intelligence) is high-

quality training data. The proper data must be used to train machine learning (ML) algorithms, which will then be more accurate and productive.
The terms training dataset, learning set, and training set are also used to refer to training data. Every machine learning model needs it since it enables them to accomplish desired tasks or generate correct predictions. Simply, the machine learning model is built using training data. It demonstrates what the desired result should look like. The model repeatedly studies the dataset to fully comprehend its characteristics and modify itself for enhanced performance. The data set was obtained from a free stock picture source, such as Google, Pinterest, etc., with a variety of image orientations and modulations. In the cloud environment, this dataset is used to train the model.
https://www.kaggle.com/datasets/constantinwerner/human-detection-dataset
Data availability: Here the data is freely available and copyright free.

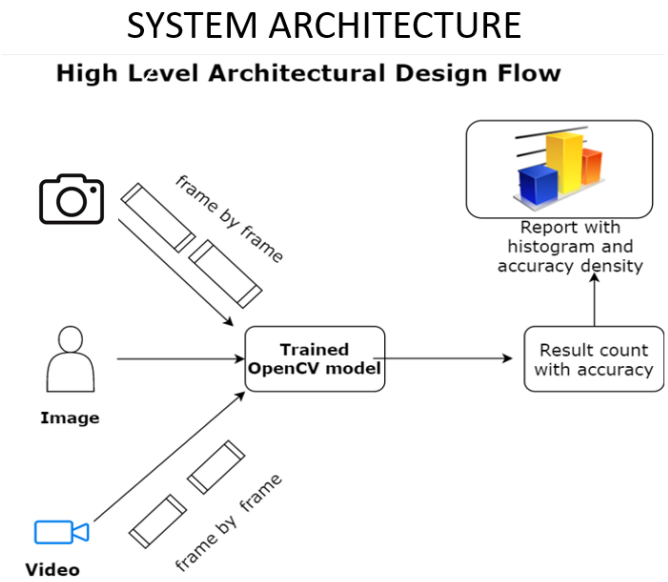
III. RESEARCH METHODOLOGY

Hypothesis:
The key benefit of the suggested application is that it minimizes the manual efforts that must be made over an extended period. To use OpenCV to increase prediction accuracy. The decision-making process should not be greatly influenced by the human's orientation in relation to the camera.

Methodology:
The developed program is assumed to be used as a standalone application for any use case that requires human detection and computing of crowd count in a certain region or to be embedded as a module to already-existing apps with API integration. It is anticipated that the feed will produce results more quickly because responses should be addressed right away.

Methodology Approach:
First, a large variety of datasets, including the image orientation ranges, are used to train the OpenCV model. The input feed comes in a variety of formats, including CCTV public IP endpoint, video as a stream of frames, and the camera still images. To produce outcomes that can be more effectively communicated through visualization, the input stream is processed.

Analysis And System Architecture:
A design flow diagram (DFD) shows how information flows through any system or process. It displays data inputs, outputs, storage locations, and routes between each destination using predefined symbols such as rectangles, circles, and arrows as well as brief text labels. Data flow diagrams can be as basic as hand-drawn process overviews or more complex, multi-level DFDs that progressively delve deeper into the data handling process. They can be used to model a new system or analyze an existing one.



IV. SYSTEM ANALYSIS

HARDWARE REQUIREMENTS:
1. SYSTEM: Intel/AMD processor with a minimum clock speed of 1.3 GHz
2. HARD DISK: 20 GB or more
3. MONITOR: 15 VGA COLOR
4. RAM: 32 GB or more

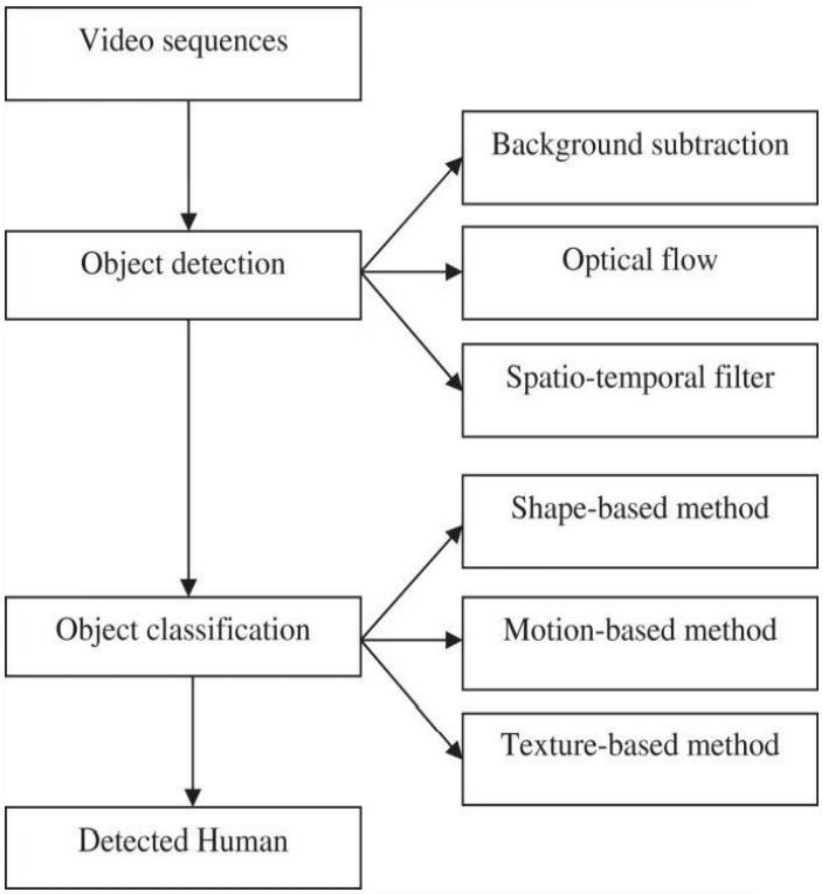
FUNCTIONAL REQUIREMENTS:
Input: The input image can be any of the following: A still image, a video, a public CCTV endpoint, or a camera connected locally.
1. OpenCV model is previously trained and deployed into the local application
2. The model is trained based on the target dataset. See how the trained model performs on test images.
Output: Humans are detected from the image and frames of video.

NON-FUNCTIONAL REQUIREMENTS:

1. Execution qualities: Efficiency
2. Evolution qualities Testability
3. Extensibility
4. Scalability
5. Usability
6. Reliability
7. Performance
8. Supportability
9. Implementation

WORKING MODEL:

The procedure of human detection is depicted in a flow chart in the accompanying Figure. We discuss and analyze recent advancements in the field of human detection, and we suggest potential future research paths. According to the general structure of movies, object recognition and object classification are described in a well-ordered manner.



V. ALGORITHMS AND LIBRARIES:

K-Means clustering:

It is one of the most straightforward and well-liked unsupervised machine learning algorithms. Unsupervised algorithms typically conclude datasets using simply input vectors, disregarding predetermined or labeled results. A cluster is a group of data items that have been combined due to their shared characteristics.

The K-means technique in data mining uses a first set of centroids that are randomly chosen as the starting points for each cluster to process the learning data.

The program then performs iterative (repetitive) calculations to optimize the positions of the centroids. When either of the following occurs:

The centroids have stabilized, and their values remain unchanged because of the clustering being successful.

There has a specified number of iterations.

Python:

It has a large and broad library and provides a rich set of modules and functions for rapid application development. GUI Programming Support: Graphical user interfaces can be developed using Python.

OpenCV:

It stands for Open-Source Computer Vision Library. This library consists of around 2000+ optimized algorithms that are useful for computer vision and machine learning.

Matplotlib:

Visualizations are the easiest way to analyze and absorb information. Visuals help to easily understand the complex problem. They help in identifying patterns, relationships, and outliers in data.

Tkinter:

Tkinter supports a range of Tcl/Tk versions, built either with or without thread support. The official Python binary release bundles Tcl/Tk 8.6 threaded.

TensorFlow:

It is a Python-friendly open-source library for numerical computation that makes machine learning and developing neural networks faster and easier TensorFlow allows developers to create dataflow graphs—structures that describe how data moves through a graph, or a series of processing nodes.

VI. SYSTEM TESTING:

Testing is centered on the following items:

Valid Input: identified classes(image formats/video formats) of valid input must be accepted. Invalid Input: identified classes of invalid input must be rejected.

Functions: identified functions must be exercised.

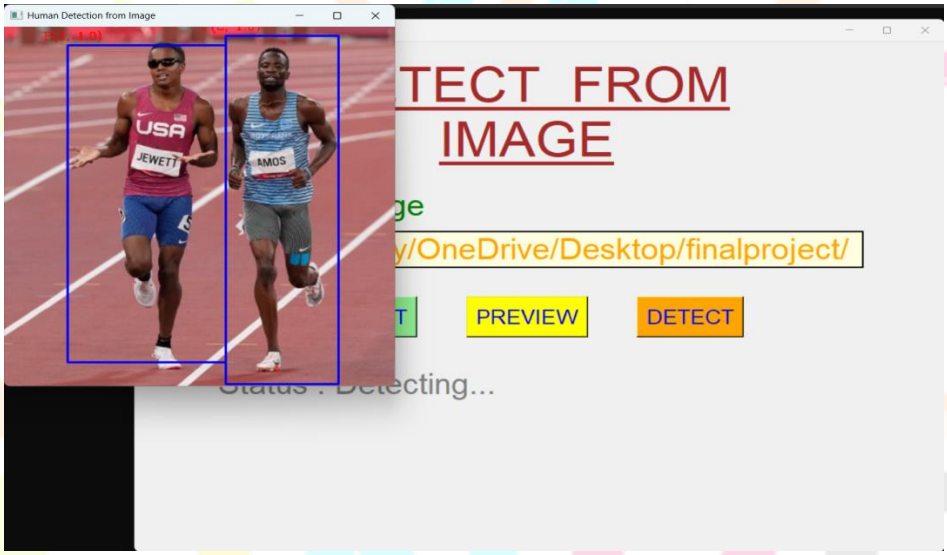
Output: identified classes of application outputs must be exercised.

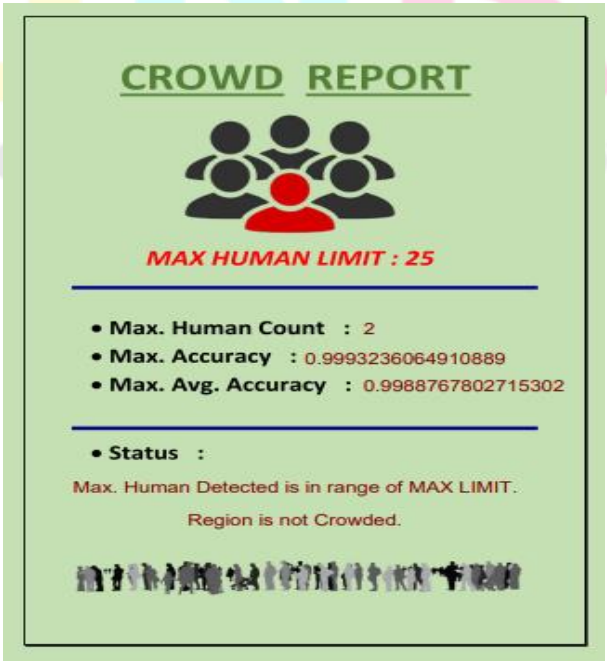
Systems/Procedures: interfacing systems or procedures must be invoked. Organization and preparation of different tests are focused on requirements, key functions, or special test cases.

In addition, systematic coverage pertaining to identifying Business process flows; data fields, predefined processes, and successive processes must be considered for testing. Before all types of testing are complete, additional tests are identified and the effective value of current tests is determined.

VII. RESULTS AND DISCUSSION

The following diagram represents the outcome set of the various inputs:





As noted, before, there are four ways that the actual user input can be obtained. One of these is through camera detection, in which the camera opens, and the input is obtained from the camera utilizing the OpenCV library to process.

The results sets are displayed by presenting the accuracy and human count relative to the entire frame as indicated when processing is finished, and results are obtained. One parameter for assessing classification models is accuracy. The percentage of predictions that our model correctly predicted is known as accuracy.

The following is the official definition of accuracy:
52 predictions total divided by the number of correct predictions equals accuracy.
Accuracy can also be determined in terms of positives and negatives for binary classification, as seen below:
Where TP = True Positives, TN = True Negatives, FP = False Positives, and FN = False Negatives

Accuracy is defined as **(TP+TN)/(TP+TN+FP+FN).**

The following describes the sample image's model accuracy:
Where the human outline is determined by the blue rectangle aspect, and the number of people in the frame as well as the accuracy probability percentage of the human occurrence are described in the bracket.

VIII. CONCLUSION

With the greatest degree of precision, we developed a program to count people in crowds. The application is supposed to take an image that the user manually uploads, a video that the user uploads, or a picture from a camera that is placed somewhere that the population needs to be watched. With this program, one can implement crowd counting to prevent unwelcome crowds in public areas. One of the main areas of vision research because of its many potential uses is effectively detecting humans in videos. The low quality of the image taken from a surveillance video makes processing it difficult.

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